REMARKS

This preliminary amendment substitutes pages 8, 9, and 11 of the Specification and eliminates all multiple dependent claims. All 12 claims are now presented to fully encompass the scope of the invention. Applicants respectfully request an early and favorable consideration of this application.

Respectfully submitted,

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The National Institute of Standards and Technology (NIST) of the United States conducted tests on the fuel oil as treated by the device of Example 2 with SANS technology. Through the comparison of the two samples, one was an ordinary fuel oil, and the other was the fuel oil treated by the device of Example 2, it was found that the former contained molecular cluster granules of larger than 300 nm in size while the size of the granules in the latter was not larger than 3 nm and remained so for at least one week.

Test method

Small angle neutron scattering (SANS) is an advanced experimental technology to probe and measure microstructure of materials. It is an especially powerful method for fluids and soft matters because of the difficulties encountered with these samples by real space probing techniques such as microscopy. The small angle neutron scattering technique measures the density distribution or fluctuation in the reciprocal space. But for most structures, specific information can be obtained about the microstructure of these samples. It is typically used to measure the granule size, shape and their distribution in complex fluids such as colloids, polymer solutions, surfactant complex, and micro-emulsions. The length scales currently available in the world's neutron laboratories are from 1 nm to 1 μ m using conventional SANS instruments.

Three sets of experiments at NIST Center were performed on different samples using NG7-SANS instrument. The neutron wavelengths used were 0.60 nm and 0.81 nm, and the momentum transfer (Q, scattering wave vector) range was from 0.008 nm^{-1} to 1 nm^{-1}, corresponding to length scales from 1 nm to 120 nm.

The fuel oil used as samples was common diesel oil obtained from a Crown Service Station in Gaithersburg, Maryland, US. The device for treating the fuel oil was a device of Example 2 provided by the present applicant. Samples were contained in cylindrical cells when it was tested. The neutron path length was 1 mm, the diameter of the neutron beam was 12.7 mm, and therefore the sample volume measured was 0.2 ml.

Test results

In the three sets of experiments, the untreated fuel oil samples as obtained were measured twice within one month. The two measurements were slightly different in Q range. The results of both measurements similarly shown that the fuel samples contained molecular clusters of size larger than 300 nm, as shown by one of the curves indicated as D1 (circle) in Figure 3. As shown in the figure, the curve increases at low-Q intensity side up to Q=0.008 nm^{-1}. This profile does not necessarily exhibit a Guinier shape. So the curve shape could not provide the size of the molecule clusters, because the size is outside and above the up-limit of the size scale measurable by the instrument. The up-limit of the size scale is the reciprocal of Q=0.008 nm^{-1}, i.e., 120

nm in radius of gyration or 310nm in spherical diameter. But basically it can be determined that these clusters are in quasi-micron size, i.e., 0.5-2 μ m.

As for the composition of these clusters, the neutron scattering instrument could not provide specific information. However it can be definitely concluded that each of such clusters move as one integral unit. Because of the fact that most molecule structures of fuel oil are smaller than 10 nm, these clusters can be deemed as molecule clusters or correlated molecules. Due to the fact that the scattering intensity is directly proportional to the product of both the quantity of these granules and their "contrast" with the rest of the fuel, it is hard to calculate either of the quantities.

However, the same fuel samples were treated with the device as described in Example 2 with the fuel going through the device under gravity. The collected samples were measured twice in a week using the same method as mentioned above with the Q scale of $0.008\ nm^{-1}<Q<1nm^{-1}$. The test result were plotted in the same figure with the above results (D4A :squares and D4B: triangles). D4A indicates results of measurement of a sample of diesel same as D1 freshly processed by the device as described in Example 2. D4B indicates the data of the same sample D4A measured one week later. The two measurements are similar, but they are markedly different from the results of the unprocessed fuel, in that they lack the increase of the intensity in low-Q. The graduation in Figure 3 is by logarithm. The average value of D4A and D4B is 1 cm^{-1} (the scattering cross sectional area per unit volume), but the intensity of D1 in low-Q is several times bigger to tens times bigger than that of D4. In fact, the whole curve can be characterized as flat, indicating that there are no measurable granules in the measurement range ($0.008nm^{-1}$ to $0.4m^{-1}$). The test was repeated twice and similar results were obtained, each using the fuel oil freshly–processed by the device in Example 2.

Conclusions

The SANS measurements show that conventional diesel fuels contain granules of size larger than 300 nm. However, these granules in the conventional sample disappear after the fuel sample is treated by the device of Example 2. The size of the granules in the treated sample is at nanometer level. No detectable granules larger than 3 nm is present in the processed fuel oil.

Example 5

The physical property changes of the nano granule fuel oil of the present invention as compared with conventional fuel oil

By conventional methods, T_2 and T_1 measurements of nuclear magnetic resonance, viscosity tests and the specific gravity tests were conducted on two diesel fuel samples before and after flowing through the device as described in Example 1 at different

before and after treatment

Test time / Test item		Original status	0H	1H	2H	3H	4H	5H	6H	7H	13H	24H
Specific Gravity	Flow rate 10L/h	0.8390	0.8380	0.8380	0.8370	0.8368	0.8371	0.8371				
	Flow rate 20L/h	0.8390	0.8390	0.8375	0.8370	0.8365	0.8365	0.8365	0.8365	0.8365	0.8370	0.8370

From the above results, it can be seen that the diesel oil has obviously changed its physical properties after passing through the device as described in Example 1, mainly including:

1) The T_1 and T_2 relaxation time of the processed diesel oil is reduced, indicating that the diesel oil molecules have been polarized by the magnetic field. Figures 4 and 5 show that the restoration process is a periodic one.
2) The viscosity of the processed diesel oil has obviously reduced, with the maximum reduction magnitude of 22.6% and 14.5% respectively for flow rates of 10L/h and 20L/h. The viscosity also has a periodic restoration process.
3) The specific gravity of the processed diesel oil has dropped, with a maximum dropping magnitude of 0.3%. After 24 hours, there is no obvious restoration on the specific gravity.

Example 6

In order to verify the performance of the nano fuel oil of the present invention, we installed the device as described in Example 2 on two Landrovers 110V8 and a DAF truck. The fuel consumption and tail gas discharge were evaluated.

Tested vehicles:
1) The first Landrover 110V8, with a mileage reading of 20193 km
2) The second Landrover 110V8 with a mileage reading of 42814 km
3) A DAF truck with a mileage reading of 37079 km.

Test items
- Fuel consumption of a vehicle without installing the device of the present invention, running 100 km at the same speed;
- CO discharge and smoke level of a vehicle without installing the device of the present invention;
- Fuel consumption of a vehicle with the device of the present invention installed, running 100 km at the same speed; and
- CO discharge and smoke level of a vehicle with the device of present

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The fuel oil used as samples was common diesel oil obtained from a Crown Service Station in Gaithersburg, Maryland, US. The device for treating the fuel oil was a device of Example [1] 2 provided by the present applicant. Samples were contained in cylindrical cells when it was tested. The neutron path length was 1 mm, the diameter of the neutron beam was 12.7 mm, and therefore the sample volume measured was 0.2 ml.

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